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TABLE 3.—Cases reported by counties, by years, and by color—Continued.

County.	Apr. 1 to Dec. 31, 1915.			Jan. 1 to June 30 and Oct. 1 to Dec. 31, 1916.		
	White.	Colored.	Com-bined.	White.	Colored.	Com-bined.
Trinity.....	180	215	395	60	24	84
Tyler.....	179	16	195	54	28	82
Upshur.....	624	458	1,082	83	30	113
Van Zandt.....	64	16	80	78	7	85
Victoria.....	34	4	38	4	.....	4
Walker.....	26	25	51	14	18	32
Waller.....	96	119	215	.....	.....	.....
Washington.....	112	29	141	6	.....	6
Wharton.....	6	2	8	25	19	44
Wichita.....	37	19	56	11	1	12
Wilbarger.....	9	.....	9	.....	.....	.....
Williamson.....	477	57	534	159	78	237
Wilson.....	37	5	42	2	1	3
Wood.....	859	217	1,076	190	106	296
Total.....	29,504	10,104	39,608	9,073	2,909	11,882

TABLE 4.—Hemoglobinuric fever reported, 1916.

County.	Period.	Cases.
Denton.....	First quarter.....	1
Hopkins.....	.....do.....	1
Wood.....	.....do.....	2
Delta.....	Second quarter.....	2
Henderson.....	Fourth quarter.....	5
Morris.....	.....do.....	1
Titus.....	.....do.....	1

TYPHOID FEVER.

EPIDEMIC AT CHARLESTON, W. VA., APRIL-JUNE, 1917.

By A. W. FREEMAN, Epidemiologist, United States Public Health Service.

During the month of May, 1917, an unusually large number of cases of a fever, diagnosed by the local physicians as typhoid, began to be reported to the health commissioner of the city of Charleston. The dates of report of these cases are given in Table 1.

During the months of May and June, 127 cases were reported, and early in May the matter attracted the attention of the West Virginia State board of health. An investigation was immediately begun by the board. Shortly afterwards request was made of the Surgeon General of the Public Health Service that an investigation be made into the causes of the epidemic. This investigation, of which the following is a report, was begun on the evening of June 16, and completed on the evening of June 26. It was conducted in cooperation with the city and State boards of health, and much of the information used in this report was obtained from these authorities.

Scope of the Investigation.

The investigation included the collection of the usual epidemiological evidence regarding all reported cases, and regarding also a number of unreported cases which were discovered during the investigation. In addition, investigation was made of the public water supply, the milk supply, and the general sanitary environment of the community. Associated with the writer were Prof. Earl B. Phelps, professor of chemistry in the Hygienic Laboratory, and Sanitary Bacteriologist E. E. Smith. Prof. Phelps conducted the investigations into the public water supply and sewerage systems, and Mr. Smith made bacteriological examinations of the raw and treated water from the public supply.

TABLE 1.—*Date of report of cases, typhoid fever, Charleston, May 1–June 25, 1917.*

Date.	Cases.	Date.	Cases.
May 1.....	2	June 1.....	4
8.....	1	2.....	1
9.....	1	4.....	9
11.....	2	7.....	12
14.....	1	8.....	12
15.....	8	9.....	4
16.....	2	11.....	2
17.....	1	12.....	7
18.....	4	13.....	8
20.....	1	14.....	1
22.....	7	16.....	6
23.....	1	17.....	3
25.....	1	18.....	2
27.....	4	19.....	1
28.....	1	20.....	3
29.....	2	21.....	2
30.....	3	22.....	1
31.....	1	23.....	3
		25.....	2
Total.....	43	Total.....	83
May.....			43
June.....			83
Unknown.....			1
Total.....			127

Epidemiological Investigations.

Epidemiological investigations were made of 141 cases of reported and probable typhoid fever. Of these, 113 were cases reported to the health commissioner by physicians, and 28 were cases occurring in the neighborhood of reported cases, which were not reported, but were discovered during the course of the investigation. The homes of these 141 patients were visited and the data collected at first hand. For the detailed work of investigation of these cases, the writer is indebted to Dr. Harold B. Wood, Assistant Commissioner of Health for West Virginia, who personally visited most of the cases and supervised the visiting of the remainder.

Diagnosis.

Of the 127 reported cases, 120 were diagnosed as typhoid fever by the attending physician. The remaining seven were diagnosed "paratyphoid" or "probable paratyphoid." The diagnoses of

"paratyphoid" and "probable paratyphoid" were all made by two physicians. The remainder of the physicians who reported cases agreed that the disease was true typhoid fever. Positive Widal's were obtained on numerous cases by the city chemist and by other physicians who made laboratory tests, and the cases seen by the writer were apparently true typhoid fever. There seems, therefore, no reason to doubt the fact that the epidemic was one of typhoid fever.

Clinical Course.

The clinical course of the disease was apparently unusually mild. Many cases had fever for only a few days, and severe cases were apparently rare. In at least one instance, however, three cases in children, members of one family, who were attacked at the same time had strikingly different courses. One child had fever for one day only, another had fever for three or four days, while the third went into a typical course of prolonged fever with the usual picture of severe typhoid infection. Only three fatalities had occurred at the time of closing the investigation.

Age Distribution of Cases.

The age distribution of the cases was quite striking, by reason of the preponderance of children among those attacked. Of the 141 cases investigated, 4 were under 1 year of age, and 29 were under 5 years of age, while 37 were between 5 and 9 years, 30 were between 10 and 14 years, and 16 were between 15 and 19 years of age. Of the 141 cases, only 29 were 20 years of age and over. The age distribution of the cases is shown in detail in Table 2.

Sex Distribution.

As is usual in typhoid outbreaks, the males were attacked in marked excess as compared with the females, 80 males being comprised in the present series as against 61 females. The preponderance of males is found at all ages, except for the group between the ages of 15 and 19, in which there were 5 males as against 11 females.

TABLE 2.—Typhoid fever, Charleston, W. Va., April-June, 1917—Age and sex distribution of cases.

Age in years.	Number of males.	Number of females.	Both sexes.	Age in years.	Number of males.	Number of females.	Both sexes.
Under 1.....	4	0	4	25 to 29.....	1	3	4
1 to 4.....	14	11	25	30 to 34.....	3	3	6
				35 to 39.....	2	1	3
Total under 5.....	18	11	29	40 to 44.....	1	0	1
5 to 9.....	23	14	37	45 and over.....	2	1	3
10 to 14.....	18	12	30				
15 to 19.....	5	11	16	Total.....	80	61	141
20 to 24.....	7	5	12				

TABLE 3.—*Occupation of patients.*

School.....	57	Park manager.....	1
None ¹	45	Waiter.....	1
Housewife.....	10	Bank clerk.....	1
Bookkeeper.....	4	Telephone operator.....	1
Nurse.....	1	Machinist.....	1
Clerk.....	1	Collector.....	1
Tailor.....	1	Soldier.....	1
Real estate.....	1	Grocer.....	2
Coal dealer.....	1	Street car conductor.....	1
Teacher.....	2	Unknown.....	5
Ax grinder.....	1		
Restaurant.....	1	Total.....	141
Servant.....	1		

TABLE 4.—*Onset of cases, by days.*

Date.	Cases.	Date.	Cases.	Date.	Cases.
Apr. 14.....	1	May 16.....	3	June 1.....	1
20.....	1	17.....	1	2.....	8
29.....	1	18.....	1	3.....	8
		19.....	3	4.....	1
	3	20.....	5	5.....	6
		21.....	1	6.....	1
May 1.....	4	22.....	2	7.....	3
2.....	4	23.....	2	8.....	6
3.....	1	24.....	4	9.....	3
4.....	4	25.....	5	10.....	6
5.....	3	26.....	5	14.....	1
6.....	7	27.....	5	15.....	1
7.....	1	28.....	4	18.....	1
8.....	3	29.....	5		
10.....	2	30.....	3		46
11.....	6	31.....	5		
12.....	1			Date unknown.....	1
15.....	1		91		

SUMMARY.

April cases.....	3
May cases.....	91
June cases.....	46
Unknown date.....	1
Total.....	141

Occupation.

As might be expected from a study of the age distribution, a large number of cases occurred in school children, and in children without occupation. The occupations of the remainder of the patients, however, were widely diversified, and included practically all grades and classes of society in Charleston. The occupations of the various cases are given in detail in Table 3.

Chronology.

The chronology of the cases is given in detail in Table 4. The first cases appeared on April 14, 20, and 29, while the epidemic proper may be said to have begun on May 1. Between May 1 and 15 occurred

¹ Mostly children under school age.

a group of cases, 36 in number. This period was succeeded by a period of four days in which only a few cases occurred, and this in turn by a period, lasting from May 19 to June 10, which was the most severe of the entire epidemic, and in which 93 cases occurred.

Location of the Cases.

The location of the cases was quite striking, in that the best residential districts of the city were most severely attacked, the outlying territory being almost free from the disease. In particular, cases occurred mainly in those portions of the city covered by the public water and sewerage systems. That portion of the city in which are found the majority of wells and privies had but few cases. The major portion of the cases were in the thickly built up sections, where general sanitary conditions are best.

Food.

Careful investigation was made into the sources of the water used regularly and of other water used occasionally for drinking by the patients, and into the source of ice, butter, ice cream, shellfish and fresh vegetables used by the patients. The results of this inquiry are summarized in the following paragraphs.

Water Supply.

There are available as sources of water supply in the city of Charleston, the public water supply, which is said to be used by approximately 90 per cent of the population, 172 private wells which serve approximately 600 families, or 10 per cent of the population, and several spring waters which are vended in the city for drinking.

Of the 141 cases, all occurred on premises supplied with the public water supply. One case, an infant of six months, was said to have drunk only boiled water, the remaining 140 having used the city water regularly for drinking. Eleven cases had been out of town during the period of probable infection and had drunk other waters at that time. Of the 141 cases investigated, however, 129 had drunk no water other than the city supply. No cases occurred in a family which used well water for domestic purposes, and no cases occurred in the users of the vended spring waters.

Milk.

There are 135 dealers supplying milk in the city of Charleston. Most of these are located in or near the city and furnish only a few gallons of milk a day. A small amount of milk is shipped in from a distance, but is pasteurized before delivery. The local milk is supplied without pasteurization. There are no large dealers, the largest dealer supplying only about 5 per cent of the population of the city.

Of the 141 cases investigated, the source of milk supply could be determined accurately in 129 cases. In 10 cases the source of the supply was not known, and in 2 cases the supply came from various sources. Of the 129 cases whose source of supply was accurately determined, 14 used no milk whatever, 16 used only condensed milk, 9 kept a cow on the premises and 7 purchased milk from a neighbor who kept a cow.

Of the 129 cases, therefore, 46, or 35.6 per cent, did not use milk from the general supply. The 83 cases using milk from the general supply were distributed among 41 different dealers, and not more than 7 cases bought milk from any one dealer.

Ice.

Of the 141 cases, the source of supply of ice was determined in 103 cases. The supply in these cases was as follows:

	Cases
Manufacturer "A".....	46
Manufacturer "B".....	23
No ice prior to illness.....	34

"A" and "B" are the only two manufacturers of ice for domestic purposes in the city. Their daily capacity is as follows:

	Tons.
Plant "A".....	42
Plant "B".....	25

The ice supplied by these manufacturers is all made from distilled water under the conditions usual in such plants.

Ice Cream.

There are no large manufacturers of ice cream in the city, and most of the cream manufactured is made from pasteurized milk or cream. Of the 141 cases of typhoid, 25 stated positively that they had not eaten any ice cream other than that made at home during the probable period of infection. The history of the remainder was doubtful as to having eaten any cream, and no evidence pointing to the use of any common source of supply could be obtained.

Shellfish.

The epidemic came at a time of the year when little or no shellfish was on the market at Charleston, and no history of having eaten any raw shellfish could be obtained from the cases.

Fresh Vegetables.

The fresh vegetables used in Charleston are almost entirely shipped in from a distance. At the time of the outbreak practically no fresh vegetables of local origin were on the market. The sources of supply

of the cases were distributed through the various dealers of the city, the large majority purchasing at the nearest greengrocery. There was no evidence of any common source of supply.

Public Entertainments.

The extent of the epidemic, lasting over a period of nearly two months, in itself precluded the possibility that the outbreak might have arisen from infection received from any single public gathering. Early in the epidemic the suspicion was aroused that the coming of two circuses, on April 28 and 30, respectively, might have given rise to the epidemic. The outbreak came too soon after the coming of these circuses, however, and lasted too long after their departure to make this supposition tenable.

Absences from Home.

Of the 141 cases, only 11 had been away from Charleston during the probable period of infection. The infection of the majority of the cases, therefore, was undoubtedly received in Charleston.

Summary of the Evidence.

The evidence presented above may be summarized as follows: The infection was evidently contracted in Charleston. The chronology and distribution of the cases would indicate that the infection was present in repeated instances in some medium of food or drink of general distribution throughout the city.

The infection was confined to those parts of the city which are supplied by the public water supply, and the sections of the city supplied by wells were markedly free from disease. The sections of the city which are unsewered, and in which surface privies are common, were also spared to a marked degree.

The infection was confined to the habitual users of the public water supply.

Milk, ice, ice cream, shellfish and fresh vegetables could be definitely excluded as possible causes of such an outbreak.

The absence of the disease in the unsewered sections of the city, the absence of flies at the beginning of the outbreak, and the general chronology of the outbreak would tend to exclude spread from insanitary privies by flies and other mechanical means as possible causes of the epidemic.

Conclusion from Epidemiological Evidence.

The conclusion to be drawn from a study of the epidemiological evidence, is that the outbreak was caused by infection conveyed by the public water supply.

Recommendations Made.

Recommendations were made to the water plant regarding the proper operation of the plant to cover the immediate emergency, and further recommendations were made that a competent bacteriologist be at once employed, and that the operation of the plant be placed in his hands with daily bacteriological controls of the raw and filtered water, continuous application of coagulants and a dose of chlorine approximately 0.5 parts per million. It is believed that these recommendations, if faithfully carried out, will prevent a similar outbreak in the future.

In view of the large number of surface privies in the city, recommendations were made to the acting health commissioner that the effort be at once made to secure the fly proofing of all privies in the city, the immediate removal of all accumulations of manure, and the general cleaning up of the community, for the purpose of preventing the access of flies to potentially infected feces and also, as far as possible, to prevent the breeding of flies. Unless these precautions are taken, a secondary outbreak of typhoid fever, caused by fly transmission, is possible.

In view of the large number of dairies supplying the city the danger of a secondary milk outbreak of large proportions is not as great as it might be. Small outbreaks may be expected, however, and can be prevented only by the installation of a pasteurizing plant for the pasteurization of all milk sold in the city.